

THE
DESCRIPTION *and* USE

OF THE
INSTRUMENT

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VARIATION and TIDE
INSTRUMENT
IMPROVED.

B. D. O. M.

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At BRISTOL.

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Both this Description and the Instrument are entered in the Hall-Book of the Company of Stationers.

Variation and Tide Instrument.

HAVING found by long Experience in Teaching, that this Instrument is of great Use in conveying just Ideas of the Nature of finding the Variation of the Compass, and readily shewing how to allow for the Variation, Lee-way, &c. I was inclined to make some Improvement for the Use of my Pupils, and now publish it for the Benefit of others.——And to render it more generally useful, have added a Tide Instrument, both according to common and new Principles.

A Description of the Instrument.

THE Instrument as now improv'd, consists of three circular Plates. 1. The largest or under Plate contains two annular or circular Spaces, marked A and B, representing the Horizon or immoveable Compass. A, contains the Points of the Compass, with their Subdivisions into Halves and Quarters. B, each Quarter of the Compass divided into 90 Degrees.

2. THE middle Plate, contains 3 circular Spaces, distinguished by C, D, and E.——C, is divided into Degrees; and D, into Points and Quarter Points, representing the magnetical or common moveable Compass. E, is a Circle of Hours and Quarters.

3. THE upper or lesser Circle. This contains two circular Spaces F and G.——G, is divided into 29 $\frac{1}{2}$ equal Parts, representing the Moon's Age, for finding the Moon's Southing and Time of High-Water, according to mean Motion.——F, is divided into unequal Parts, denoting Days and Quarters of Days, before and after Full, Change, and Quarter

Days of the Moon; for the more accurately finding the Time of High-Water, as will be explained farther on.

The Use of the Instrument.

PROBLEM 1. *To find the Variation of the Compass.*

HAVING set the Sun by your Compass, and noted the Bearing, called, if the Sun be rising or setting, the magnetical Amplitude; but if taken at any other Time of the Day, the magnetical Azimuth: Observe this Rule. Lay the String on the true Amplitude or Azimuth, in the circular Space B, and turn the moveable Compass about, until the magnetical Amplitude or Azimuth on the circular Space C, comes under the String, then will the North Point of the moveable Compass shew the Variation, on the circular Space B, of the immoveable.

EXAMPLE. Suppose at Sea, when the Sun was S. 30° E. by the Compass, I found it was S. 50° E. by Astronomy; what is the Variation?

HERE laying the String on S. 50° E. on the Space B, and moving the Middle Plate about, when S. 30° E. on C, comes under the String, you will find the North Point of this Plate, point to N. 20 Degrees West on the large Plate; or in other Words, the Compass has 20 Degrees West Variation.

PROBLEM 2. *Knowing the Variation of the Compass, to correct the Course steered by the Compass.*

SET the North Point on the middle Plate, to the Variation on the large Plate; then laying the String over the Course steered by the Compass on the middle Plate, it will, if extended, cut the true Course on the large Plate.

EXAMPLE 1. In a Place where the Variation is 3 Quarters of a Point Easterly, a Ship sails E. N. E. what is the Course made good, she making no Lee-Way?

to LAY the String on N. 3 Quarters East, on the large Plate, then turning the middle Plate about, until its North Point comes under the String, keep it there; and laying the String over E. N. E. on the Space D, it will cut E. N. E. 3 Quarters East on the Space A; the true Course required.

EXAMPLE 2. The Variation of the Compass being 1 Point Westerly, the Lee-way $1\frac{1}{2}$ Point, and the Wind at S. W. a Ship steers by Compass S. S. E. What is the Course made good? —

First, to allow the Lee-way; laying the String on the S. S. E. Point, representing the Course steered, it is plain, the Wind blowing S. W. must drive the Ship towards the East, therefore, counting $1\frac{1}{2}$ Point Eastward from S. S. E. brings the Course made good if no Variation, to be S. E. b. S. $\frac{1}{2}$ E. Then 1 Point West Variation being allowed on this, by the above Rule, will bring out the true Course S. E. $\frac{1}{2}$ E.

PROBLEM 3. *The true Course from any Place to another being found by a Chart or otherwise, to find what Compass Course a Ship must steer, to make that Course good, the Variation and Lee-way being given.* —

LET the EXAMPLE be the reverse of the last; viz. suppose the Variation of the Compass 1 Point Westerly, the Wind at S. W. and the Lee-way $1\frac{1}{2}$ Point; required what Course the Ship must steer by the Compass, to make good a S. E. $\frac{1}{2}$ E. Course? —

First, Set the North Point of the middle Plate to the Variation on the large Plate; then laying the String on the true Course S. E. $\frac{1}{2}$ E. on the Space A, it will cut on the Space D, S. E. b. S. $\frac{1}{2}$ East; which is the Compass Course answering to the true S. E. $\frac{1}{2}$ E. and would be that required, if there was no Lee-way; But as the Ship makes $1\frac{1}{2}$ Point Lee-way, lay the String on S. E. b. S. $\frac{1}{2}$ E. and to make that Course good, we must lie up $1\frac{1}{2}$ Point nearer the Wind, therefore the Ship must steer S. S. E.

There is much is sufficient to shew the Usefulness of that Part of the Instrument, which relates to the Variation and Lee-way: I shall therefore proceed to shew the Use of what concerns the Tides.

PROBLEM 4. To find the Moon's Southing, according to mean Motion, her Age being given.

RULE. Set the New Moon on F, to the upper 12 or North Point on the middle Plate; then laying the String over the Moon's Age on the Space G, it will cut the Time of her Southing in the Space of Hours E.

Thus for **EXAMPLE**, it will be found, that, when the Moon is 5 Days old, she is South at 4 Minutes after 4 in the Afternoon.

PROBLEM 5. To find the Time of High-Water, according to mean Motion.

Set the New Moon on the upper Plate, to the Time of High-Water at New or Full Moon, (called the Flowing) on the middle Plate; then the String being laid over the Moon's Age, in the Space G, will cut on the Space E, the Time of High-Water required.

EXAMPLE. Let it be required to find the Time of High-Water at Bristol the 2d of May, 1766.

EPOCH 18
Day of Month 2
N^o. of Month 5
Moon's Age 23 Days.

In this Example, the New Moon being made to correspond to the Flowing at Bristol, 7^h 8^m against the Moon's Age 22, will be 1^h 50^m the Time of High-Water in the Afternoon.

PROBLEM 6. *To find the Time of High-Water, by Means of the circular Space F, which is constructed on new, and more accurate Principles.*

Look in the Mariner's Calendar, or an Almanack, for the nearest Phase of the Moon, to the given Day; which, being calculated for London, reduce to the Meridian you are in, by subtracting the Difference of Longitude in Time, if you are in West Longitude; or adding it in East Longitude.

TAKE the Difference between the Time of the Moon's nearest Phase, and the given Day at Noon; which call the Interval. Then, setting the New Moon in the Space F, to the Time of Flowing in the Space E; against that Interval on F, will be the approximated Time of High-Water on E. But in order to have it more accurate, with the Interval between the approximated Time of High-Water, and the Time of the Moon's nearest Phase, find the true Time of High-Water.

Let the Example be as in the preceding Problem.

By an Almanack, the Moon is in her last Quarter the 1st Day at 8 at Night.

The Difference of Meridians between London and Bristol is too little to be taken into Account.

The 2d Day Noon expressed Astronomically is	— — — — —	Days Hours.
	— — — — —	2 0

The Moon's last Quarter at	— — — — —	1 8
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Interval of Time after the Moon's 3d Quarter, is	— — — — —	0 16
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or near 3 Quarters of a Day.

The New Moon being set to the Flowing 7^h 8^m; the Interval 16 Hours, or 2 Quarters of a Day nearly, after the 3d Quarter, corresponds to about one Hour, for the approximated Time of High-Water.

Now, if the true Time of High-Water be required for the Morning: —

The 2d Day 1 o'Clock in the Morning? Days Hours.
expressed Astronomically is — } 1 13
The Moon's Quarters — — } 1 8

Interval after the 3d Quarter, is — } 0 5

The Instrument remaining as before, this Interval which is near 1 Quarter of a Day after the 3d Quarter, gives about Half an Hour after Midnight.

But if the Time of High-Water be required for the Afternoon: —

Then, the approximated Time 1 Hour? Days Hours.
in the Afternoon is — — } 2 1
The Moon quarters at — — } 1 8

Interval after 3d Quarter — — } 0 17
That is, about 3 Quarters of a Day.

The Instrument still being in the same Position, 3 Quarters of a Day after the 3d Quarter, gives 3 Minutes after 1, for the Time of High-Water in the Afternoon.

N. B. The common Method is nearly true about the Full and Change of the Moon; but is generally very erroneous at the Quadratures.

8 1 — THE END.

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The Author, as soon as Leisure will permit, intends to present the Public with a New Treatise on NAVIGATION: And therefore, would gladly receive (Post-paid) any accurate Observations of Latitudes, Longitudes, Variation and Tides, &c.

